Memorandum

To:	Chris Hempleman
Cc:	Dustin Bilhimer, Greg Pelletier, Kirk Sinclair, Lawrence Sullivan, Trevor Swanson, Karol Erickson
From:	Mindy Roberts
Date:	February 28, 2005
Subject:	Deschutes River, Capitol Lake, Budd Inlet TMDL Quarterly Progress Report #7 (October through December 2004)

Introduction

The Deschutes River, Capitol Lake, Budd Inlet, and tributaries were placed on the 1996 and/or 1998 Clean Water Act Section 303(d) list of impaired waters based on historical monitoring by several organizations. In total, 24 water bodies have water quality parameter levels that do not meet standards for at least one of the following: temperature, fecal coliform bacteria, dissolved oxygen, pH, nutrients, or fine sediment. The TMDL study began in March 2003 to assess the current condition of the water bodies and to identify and quantify factors contributing to the impairments. The previous quarterly progress reports (July 31, 2003; December 1, 2003; February 9, 2004; April 15, 2004; August 30, 2004; and October 29, 2004) summarized the results of the 2003 monitoring program and earlier 2004 results.

This memorandum summarizes the progress to date related to data collection and project communications. Data presented are provisional; data quality has not been checked.

Progress to Date

Temperature and Hydrogeology Data Collection

Temperature data collected from surface water, hyporheic sites, and air sites were compiled into an Access database. Figure 1 presents an example of temperature monitoring data for the Deschutes River at Military Road to illustrate seasonal patterns in surface water and hyporheic temperatures.

The Deschutes temperature dataset is one of the most complete datasets collected by Ecology, providing a continuous record from June 2003 through September 2004. Three monitoring stations have been retained in the Deschutes to continue collecting temperature data for long-term data analysis not specific to the Deschutes system to evaluate seasonal and inter-annual variation in temperatures. Each station includes a piezometer equipped with three stacked thermistors (same depths as before), an instream thermistor and an air thermistor. The three stations are located at Henderson Rd (13-DES-02.7), at the USGS gage (13-DES-24.9), and at a private residence not far downstream from the Weyerhaeuser Vail tree farm (13-DES-33.5). Monthly hydraulic gradient measurements will continue.

The temperature data are being compared with fluxes estimated using the VS2DH model for the Deschutes River and Percival Creek. The preliminary groundwater fluxes for the upper Deschutes R. (RM 42.3 to RM 20.5) compare favorably with the flux volumes measured during the August 2003 seepage run. The lower river (RM 20.5 to RM 0.5) will be evaluated next.

Conventional Water Quality Parameter Data Collection and Planning

Routine monitoring for fecal coliform, DO, pH, nutrients, and related parameters concluded in December 2004. Samples were collected from the Deschutes River, Capitol Lake, their tributaries, and tributaries to Budd Inlet twice monthly and analyzed for fecal coliform bacteria. Concentrations greater than 200/100 mL were found once during the three-month period in Butler, Ellis, and Moxlie at both 5th and 8th Avenue. Multiple samples from Adams, Indian, Mission, Moxlie, and Schneider Creeks had concentrations over 200/100 mL. Levels are consistently elevated in Mission and Moxlie Creeks. In addition, a highly concentrated source continued to contribute to levels near the head of Adams Creek. Table 1 presents the fecal coliform data collected from routine monitoring stations from October through December 2004.

Nutrient samples were collected monthly through December. Table 2 presents the results along with alkalinity and TSS data. Total persulfate nitrogen (TPN) continue to exhibit a longitudinal gradient from 0.2 to 0.3 mg/L at 1000 Rd to 0.6 to 0.8 mg/L at Henderson Blvd and E Street, with nitrate plus nitrite constituting 80 to over 95% of the total. Ammonia levels were elevated (>0.02 mg/L) at Adams Creek, Ayer Creek, Black Lake Ditch, Capitol Lake, Indian Creek, Mission Creek, Moxlie Creek, Percival Creek, and Reichel Creek. The highest nitrogen levels continue to be found in Chambers Creek, but total nitrogen values exceeded 1 mg/L in Adams, Butler, Ellis, and Mission Creeks as well. Percival Creek nitrogen levels were similar to but lower overall than in the Deschutes system. Capitol Lake (railroad trestle and outlet) nitrogen concentrations are lower than Deschutes River concentrations.

Total phosphorus and orthophosphate show similar longitudinal trends in the Deschutes River, with levels generally increasing downstream from 0.006 to 0.02 mg/L for both; 75% to 100% of the phosphorus is in orthophosphate form. Capitol Lake total phosphorus and orthophosphate levels were slightly greater than those in the Deschutes River. Within Capitol Lake most phosphorus is in the inorganic form. Percival Creek phosphorus concentrations were higher than those in the Deschutes system. Mission, Adams upstream, and Ellis Creeks had the highest total phosphorus and orthophosphate levels in the system.

Organic carbon levels are relatively low throughout the Deschutes River system, and nearly all carbon is in the dissolved form. Capitol Lake levels were higher than those in the Deschutes inflow, and most was in dissolved form. Percival Creek organic carbon levels are higher than in the Deschutes River with most in dissolved form. Adams upstream, Ellis, Mission, and Reichel Creeks had organic carbon levels >10 mg/L.

Alkalinity levels in the Deschutes River continue to exhibit a weak longitudinal gradient from 30 mg/L upstream to 40 mg/L downstream. TSS levels were <4 mg/L throughout the system.

Table 3 presents dissolved oxygen results obtained from Winkler titrations of grab samples. Samples are collected during daylight hours and represent a mix of morning and afternoon results. Ayer Creek DO levels were well below the water quality standard of 8 mg/L. Reichel and Black Lake Ditch also exhibited levels <8 mg/L, while all other sites had higher DO levels.

Ayer Creek and Adams (upstream) had pH levels <6.5, as shown in Table 4. Capitol Lake pH reached 9.4 in early October.

Table 5 presents BOD5 data for several sites. Only the sample from Percival Creek in October was greater than the detection limit.

Table 6 presents discrete flow monitoring data.

Stormwater Monitoring

Table 7 presents the fecal coliform data for the October 2004 dry weather event and December 2004 wet weather event. Stations within the Indian and Mission Creek watersheds had values >200/100 mL in dry weather, but during wet weather, elevated levels were found throughout the system. No elevated values were found in Spurgeon and Ayer Creeks, and only moderate levels were found throughout the Percival Creek/Black Lake Ditch watershed. The highest concentrations were found within the Adams and Indian Creek watersheds.

Capitol Lake Bathymetry Survey

The South Basin was revisited November 4, 2004. Lake surface water level was recorded at the beginning and end of the survey, and the time and magnitude of the highest level were estimated in the field. Over 180 points were occupied by kayak. At each point, horizontal location was determined using a Trimble gps (accuracy <1m), and depth from the water surface to the sediment recorded at 0.05-foot intervals using a weighted tape measure. The data are being evaluated and will be compared and merged with February 2005 data collected by the SEA Program in South Basin and Percival Cove.

Capitol Lake Algae

Samples were collected from the surface at three locations in Capitol Lake monthly from July 13, 2004 through September 29, 2004. Aquatic Analysts identified the phytoplankton species, enumerated cell densities, and quantified volume. Table 8 provides the complete species list over all of the samples. As illustrated in Figure 2, diatoms dominated the algal counts at station CL-1, located in the South Basin southeast of the I-5 bridge, and remained constant over the four samples. While counts were relatively low in June at stations CL-3 and CL-4, a green algae bloom occurred in July when *Golenkinia paucispina* counts increased. Diatom counts (*Stephanodiscus hantzschii* and *Cyclotella stelligera*) increased in July as well. By August, blue-green algae, *Anabaena circinalis*, increased substantially, before being replaced by diatoms (*Stephanodiscus hantzschii*) in September. Because *Anabaena* have greater volume than the green algae, the volume of phytoplankton, presented in Figure 3, was greatest in August 2004. By September, algal biomass had returned to July levels following the bloom.

Benthic Flux Chambers

Benthic flux chambers were deployed in September 2004, but the results were not available at the time of publication of the previous quarterly report. Temperature, dissolved oxygen, pH, and specific conductance were monitored continuously over two to three days in three chambers alternately placed throughout the north, middle, and south basins. Each unit was built from a 1-foot wide by 1-foot deep by 3-feet long clear acrylic aquarium. A partition in the middle separated two chambers and provided a mount for two Hydrolabs (with stirrer) to record in either the light or dark chamber; the dark chamber was created by painting the acrylic so no light entered. The three chambers were deployed at four locations for varying lengths of time.

- Unit #1 was deployed in the southwest corner of the middle basin for 47 hours beginning September 28, 2004 at 11:30 a.m.
- Unit #2 was deployed on the east side of the middle basin for 21 hours beginning September 28, 2004 at 11:30 a.m.
- Unit #2 was collected from the middle basin and redeployed in the north basin for 19 hours beginning September 29, 2004 at 1:30 p.m.
- Unit #3 was deployed in the south basin for 28 hours beginning September 28, 2004 at 12:30 p.m.

Figure 4 presents discrete nutrient data and continuous DO, temperature, conductivity, and pH data for Unit #1 in the southwest corner of the middle basin. In the light chamber, total phosphorus, orthophosphate, and ammonium concentrations increase over time, while nitrate+nitrite and dissolved total nitrogen[1] decrease. Dissolved oxygen levels decrease, with the effects of productivity apparent in daily peak values. The pH declines over time, with small increases coinciding with increases in dissolved oxygen. Conductivity steadily increases. In the dark chamber, the nutrient increases and decreases are of greater magnitude than in the light chamber. The pH record does not show the small increases during afternoon hours that the light chamber record does. The dark chamber DO sensor failed and no data were recovered.

The middle basin east side deployment shown in Figure 5 shows little change in total phosphorus, orthophosphate, and dissolved total nitrogen in either the dark or light chamber. Ammonium gain and nitrate+nitrite loss are greater in the dark chamber than in the light, consistent with the longer record for Unit #1. Organic carbon increases in both chambers, but the increase is of greater magnitude in the dark chamber; very little particulate organic carbon was found. Dissolved oxygen, pH, and conductivity showed greater short-term variation in the light chamber than in other continuous data time series. DO exhibited a downward trend over time but the short time series makes quantification difficult. In the dark chamber, the DO level decreased by 7.4 mg/L in a day.

Equipment malfunction in the second Unit #2 deployment in the north basin truncated the continuous data records in the light chamber, shown in Figure 6. In the dark chamber, DO levels decreased 4.3 mg/L in 19 hours.

In the south basin deployment shown in Figure 7, orthophosphate levels did not change much over time in either chamber, although total phosphorus levels increased significantly in the dark chamber. Ammonium levels rose in both chambers, with a higher increase in the dark chamber, consistent with the other chambers. Nitrate+nitrite and dissolved total nitrogen declined over time. DO levels decreased in both chambers, with higher losses in the dark chamber than in the light and no evidence of afternoon increases in DO indicative of algal productivity. The pH and conductivity sensors failed in the light chamber, but dark chamber results show a slow decrease in pH and increase in conductivity, consistent with the other chambers.

Chamber dimensions have not been verified, but based on estimates of effective sediment cross-sectional area and effective chamber volume (including the water displaced by the Hydrolabs), Table 9 provides initial estimates of sediment oxygen demand (SOD). In both units with coincident light- and dark-chamber results, SOD was higher in the dark chamber.

Communication and Coordination

- On January 10, 2005, Dustin Bilhimer sent the flow data from the 2003 streamwalk to Mary Raines, NWIFC, who is under contract to the Squaxin Island Tribe.
- Compile sediment-related project data and sent to Mary Raines.

Project Schedule and Upcoming Tasks

All but the stormwater monitoring program were completed in December 2004. In addition to completing remaining data collection, we will begin analyzing data and preparing water quality models:

[1] Vertically separated points represent replicate samples that have not been averaged for data presentation purposes.

- March 3 Technical Advisory Group meeting at Ecology in Lacey.
- Track storms for potential wet-weather sampling events.
- Continue to maintain long-term Deschutes River temperature monitoring stations at Henderson Rd., the USGS gage at Rainier, and downstream of the Vail Tree Farm.
- Complete a draft groundwater/hydrogeologic report of the Deschutes River temperature monitoring and hyporheic modeling efforts.
- Prepare poster for the Washington Hydrogeology Symposium summarizing Deschutes project hydrogeology results to date.
- Begin developing QUAL2KW model of the Percival system and continue with the development of the Deschutes River QUAL2KW model for temperature, DO, and pH.
- SEA Program continuing to fill in missing bathymetry data in Percival Cove.
- Transmitting historical Capitol Lake water quality data to Edinger Associates for model development.

We distributed the previous quarterly report via the Deschutes website in October 2004. The next quarterly report will be prepared and distributed in April 2005.

Tables and Figures

Table 1. Fecal coliform data collected at routine monitoring stations between October and December 2004. Highlighted values are >200/100 mL.

Station	10/12/2004	10/13/2004	10/26/2004	11/16/2004	11/30/2004	12/14/2004	12/28/2004
Mainstem Deschutes River							
13-DES-00.5	23		47	24	11	18	7
13-DES-02.7		21	21	76	5	38	5
13-DES-05.5		19	41	72	6	15	14
13-DES-09.2		49	100	35	15	42	10
13-DES-20.5		28	27	7	9	15	5
13-DES-28.6		18.5	34	13	17	13	2
Deschutes River Tributaries							
13-AYE-00.0		3	55	1	1	20	5
13-CHA-00.1		33	30	3	2	18	14
13-HUC-00.3		1	2	1	1	15	1
13-REI-00.9		32	35	52	15	30	10
13-SPU-00.0		8	36.5	15	2	6	45
Capitol Lake, Percival Creek, and Tributaries							
13-BLA-00.0	11		12	5	8	20	4
13-BLA-02.3	4		1	2	7	27	7
13-PER-00.1	23		32	8.5	5	28	6
13-PER-01.0	88		140	7	53	61	17
13-CAP-00.4	3		120	70	52	65	25
Budd Inlet Tributaries							
13-ADA-00.5	18		280	15	42	660	31
13-ADA-UNK	8		5700	840	30	1600	31
13-BUT-00.1	49		350	3	4	85	11
13-ELL-00.0	24		320	27	5	75	25
13-ELL-33RD	27						
13-IND-00.2	130		1500	120	51	570	23
13-MIS-00.1	120		15000	210	70	240	43
13-MOX-00.0	1200		1200	930	1800	450	130
13-MOX-00.6	36.5		460	44	69	470	120
13-MOX-5TH						330	
13-MOX-8TH						270	
13-SCH-00.1			350	63	4	560	8

Table 2. Nutrient, alkalinity, and TSS data collected between October and December 2004.

Date	Station	TPN (mg/L)	NO23N (mg/L)	NH3 (mg/L)	TP (mg/L)	OP (mg/L)	TOC (mg/L)	DOC (mg/L)	ALK (mg/L)	TSS (mg/L)
10/5/2004	13-BUT-00.1	1.390	1.370	0.010	0.028	0.031	1.1	1.0		
	13-IND-00.2	0.979	0.913	0.012	0.036	0.024	2.3	1.8		
	13-MIS-00.1	1.043	0.982	0.019	0.120	0.102	2.5	2.4		
	13-MOX-00.0	0.685	0.629	0.021	0.072	0.057	1.2	1.1		
	13-PER-00.1	0.498	0.209	0.069	0.042	0.021	4.4	3.9		
	13-SPU-00.0	0.140	0.010	0.010	0.019	0.018	2.5	2.3		
10/12/2004	13-ADA-00.5	1.170	1.200	0.010	0.026	0.017	1.0	1.0		
	13-ADA-UNK	0.503	0.169	0.019	0.047	0.022	11.2	10.4		

	13-ELL-00.0	0.792	0.676	0.020	0.059	0.040	4.1	3.9		
10/13/2004	13-AYE-00.0	0.339	0.049	0.073	0.066	0.025	4.3	3.5		
	13-LAK-00.0	1.735	1.660	0.100	0.048	0.007	1.7	1.6		
10/26/2004	13-AYE-00.0	0.336	0.067	0.036	0.051	0.027	4.3	4.2		
	13-BLA-02.3	0.340	0.091	0.036	0.030	0.014				
	13-CAP-00.4	0.536	0.498	0.037	0.025	0.018	2.2	2.1		1
	13-CHA-00.1	1.585	1.490	0.012	0.014	0.013	3.6	3.2		
	13-DES-00.5	0.608	0.582	0.010	0.018	0.016	2.0	1.8	39.6	1
	13-DES-02.7	0.633	0.581	0.010	0.014	0.016	1.7	2.1	39.1	2
	13-DES-05.5	0.535	0.495	0.010	0.014	0.011	1.8	2.0	36.8	2
	13-DES-09.2	0.564	0.519	0.010	0.012	0.012	1.9	1.8	36.1	2
	13-DES-20.5	0.409	0.345	0.010	0.012	0.010	2.1	2.0	34.5	1
	13-DES-28.6	0.263	0.223	0.010	0.008	0.008	1.8	1.3	32.2	1
	13-DES-37.4	0.170	0.141	0.010	0.006	0.008	1.4	1.3	30.1	1
	13-PER-00.1	0.538	0.297	0.519	0.039	0.023	6.0	5.3		3
	13-PER-01.0	0.474	0.317	0.010	0.024	0.013				
	13-REI-00.9	0.743	0.248	0.010	0.053	0.022	13.0	14.0		
	13-SPU-00.0	0.195	0.080	0.010	0.019	0.017	3.7	3.6		
11/30/2004	13-AYE-00.0	0.683	0.271	0.044	0.062	0.031	7.3	7.9		
	13-BLA-02.3	0.373	0.151	0.010	0.026	0.014				
	13-CAP-00.0	0.692	0.561	0.026	0.026	0.017	2.9	2.6		2
	13-CAP-00.4	0.670	0.529	0.019	0.016	0.016	2.7	3.0		4
	13-CHA-00.1	1.950	1.770	0.010	0.012	0.013	2.7	2.4		
	13-DES-00.5	0.784	0.687	0.010	0.017	0.013	1.7	1.6	39.0	1
	13-DES-02.7	0.806	0.693	0.010	0.016	0.014	1.6	1.6	38.0	1
	13-DES-05.5	0.750	0.620	0.010	0.013	0.010	2.0	1.9	35.0	1
	13-DES-09.2	0.730	0.636	0.010	0.010	0.009	1.9	2.2	36.0	1
	13-DES-20.5	0.525	0.428	0.010	0.010	0.009	1.8	1.8	35.0	1
	13-DES-28.6	0.347	0.273	0.010	0.006	0.006	1.5	1.4	32.0	1
	13-DES-37.4	0.257	0.203	0.010	0.006	0.007	1.3	1.2	29.0	1
	13-PER-00.1	0.504	0.264	0.010	0.029	0.016	6.1	5.6		3.5
	13-PER-01.0	0.703	0.508	0.010	0.018	0.011				
	13-REI-00.9	0.876	0.516	0.010	0.042	0.017	9.2	9.1		
	13-SPU-00.0	0.452	0.318	0.010	0.018	0.018	2.9	3.2		
12/7/04	13-ADA-00.5	1.455	1.360	0.010	0.028	0.015	3.0	2.6		
	13-ADA-UNK	1.015	0.556	0.033	0.081	0.032	14.0	14.5		
	13-AYE-00.0	0.563	0.256	0.046	0.056	0.033	7.2	7.3		
	13-BUT-00.1	1.425	1.280	0.010	0.038	0.017	5.1	4.9		
	13-ELL-00.0	0.843	0.583	0.018	0.061	0.026	10.0	10.0		
	13-IND-00.2	0.778	0.556	0.058	0.050	0.016	6.6	6.0		
	13-MIS-00.1	0.806	0.557	0.029	0.087	0.043	10.0	10.0		
	13-MOX-00.0	0.772	0.538	0.100	0.091	0.063	4.0	3.2		
	13-PER-00.1	0.484	0.293	0.025	0.039	0.017	6.2	5.7		
	13-SPU-00.0	0.398	0.309	0.010	0.021	0.018	2.6	2.4		
12/8/2004	13-ADA-00.5	0.930	0.765	0.023	0.074	0.034	5.1	4.6		
	13-ADA-UNK	1.343	0.864	0.043	0.230	0.128	13.0	13.0		
	13-AYE-00.0	0.578	0.228	0.055	0.066	0.037	7.2	7.0		
	13-BUT-00.1	1.735	1.460	0.011	0.041	0.016	6.3	5.6		
	13-ELL-00.0	1.250	0.943	0.018	0.109	0.024	12.0	11.0		

	13-IND-00.2	0.693	0.410	0.154	0.071	0.013	5.8	4.8		
	13-MIS-00.1	0.817	0.459	0.039	0.075	0.033	9.9	11.0		
	13-MOX-00.0	0.637	0.480	0.101	0.085	0.053	4.4	4.1		
	13-PER-00.1	0.718	0.441	0.030	0.036	0.015	7.8	7.5		
	13-SPU-00.0	0.418	0.298	0.010	0.025	0.019	3.2	3.4		
12/28/2004	13-AYE-00.0	0.710	0.460	0.048	0.072	0.046	7.8	7.5		
	13-BLA-02.3	0.394	0.234	0.013	0.023	0.014				
	13-CAP-00.0	0.741	0.659	0.024	0.026	0.016	2.0	2.1		2
	13-CAP-00.4	0.707	0.600	0.020	0.024	0.016	2.5	2.6		2
	13-CHA-00.1	1.735	1.840	0.012	0.015	0.013	1.9	1.9		
	13-DES-00.5	0.801	0.752	0.010	0.020	0.015	1.6	1.9	39.4	1
	13-DES-02.7	0.793	0.754	0.010	0.021	0.016	1.5	1.3	39.5	2
	13-DES-05.5	0.759	0.702	0.010	0.017	0.013	1.6	1.6	37.0	2
	13-DES-09.2	0.728	0.711	0.010	0.016	0.016	1.6	1.8	36.0	3
	13-DES-20.5	0.567	0.536	0.010	0.015	0.012	1.6	1.6	34.0	2
	13-DES-28.6	0.389	0.387	0.010	0.010	0.009	1.6	1.1	32.0	1
	13-DES-37.4	0.270	0.264	0.010	0.009	0.008	1.5	1.1	29.5	1
	13-PER-00.1	0.451	0.309	0.019	0.025	0.014	4.7	4.7		2
	13-PER-01.0	0.645	0.593	0.010	0.021	0.010				
	13-REI-00.9	0.749	0.524	0.024	0.041	0.018	8.0	7.6		
	13-SPU-00.0	0.591	0.485	0.012	0.027	0.020	2.4	3.4		

Table 3. Dissolved oxygen (Winkler titration) data collected between October and December 2004. Highlighted values are <8 mg/L.

Station	10/12/04	10/13/04	10/26/04	11/16/04	11/30/04	12/7/04	12/14/04	12/28/04
Mainstem Deschutes River								
Deschutes at 1000 Rd		11.00	11.40	12.10	12.70		11.60	12.76
Deschutes at Vail Cutoff Rd SE		11.09	11.20	11.81	12.45		11.14	12.26
Deschutes at Rte 507		10.98	11.03	11.38	12.55		11.20	12.20
Deschutes nr Rich Rd		10.85	10.98	11.06	12.32		11.00	11.73
Deschutes off Riverlea		10.40	10.87	10.90	12.21		11.02	11.65
Deschutes at Henderson	10.01				11.75		10.85	11.42
Deschutes at E St	10.21		10.75		12.00		10.85	
Upper Deschutes Tributaries								
Huckleberry		9.98	10.57	10.62	11.69		11.08	12.02
Reichel		5.58	6.89	7.95	9.95		8.47	10.03
Lower Deschutes Tributaries								
Spurgeon		9.95	10.52	10.75	12.38		10.60	11.78
Ayer		2.40	3.64	3.08	4.61	4.5 (est)	3.36	4.73
Chambers			8.90	8.86	10.65		9.15	10.68
Capitol Lake and Tributaries								
Black Lk Ditch at Belmore	7.06		7.73		9.80		10.30	9.90
Black Lk Ditch nr Percival	8.40		8.75		10.65		10.55	10.82
Percival nr Black Lk Ditch confluence	10.00		10.45		11.90		11.19	11.75
Percival nr mouth	8.87		9.76		11.50		11.43	11.60
Capitol Lk at RR trestle	10.94		10.30		12.00		11.72	11.80
Capitol Lk at 5th Ave	14.09				11.83		11.85	11.74

Table 4. pH data collected between October and December 2004. Highlighted values are <6.5 SU or >8.5 SU.

Station	10/12/04	10/13/04	10/26/04	11/16/04	11/30/04	12/7/04	12/8/04	12/14/04	12/28/04
Mainstem Deschutes River									
Deschutes at 1000 Rd		7.83							
Deschutes at Vail Cutoff Rd SE		7.57							
Deschutes at Rte 507		7.69							
Deschutes nr Rich Rd		7.45							
Deschutes off Riverlea		7.30							
Deschutes at Henderson	7.64		7.37	7.32	7.17			7.50	
Deschutes at E St	7.66		7.42	7.36	7.20			7.42	
Upper Deschutes Tributaries									
Huckleberry		7.35							
Reichel		6.52							
Lower Deschutes Tributaries									
Spurgeon		7.39							
Ayer		6.33							
Chambers		6.97							
Capitol Lake and Tributaries									
Black Lk Ditch at Belmore	7.36		7.23	7.31	7.32	7.67	7.13	7.40	7.02
Black Lk Ditch nr Percival	7.36		7.20	7.13	7.10	7.22	7.05	7.20	6.94
Percival nr Black Lk Ditch confluence	7.56		7.33	7.34	7.19	7.20	7.06	7.14	7.12
Percival nr mouth	7.85		7.52	7.50	7.44	7.34	7.26	7.38	
Capitol Lk at RR trestle	9.44		7.36	7.37	7.41			7.43	
Capitol Lk at 5th Ave	7.80			7.38	7.36			7.50	7.43
Budd Inlet Tributaries									
Adams	6.83		6.88	7.04	7.00		6.49	6.72	6.50
Adams upstream	7.25		6.85	7.13	6.86	6.82	6.53	6.26	6.65
Butler	7.64		7.30	7.38	7.28		7.33	7.31	7.44
Ellis	7.30		7.25	7.40	7.50	7.71	6.87	7.10	7.16
Indian	7.53		7.16	7.28	7.22	6.81		7.11	7.27
Mission	7.55		7.32	7.34	7.16	6.97	6.94	7.33	7.41
Moxlie at Plum and Henderson	7.67		7.34	7.31	7.46	7.78		7.07	7.43
Moxlie at East Bay						7.10			
Schneider			7.45	7.49	7.58			7.20	7.55

Table 5. Biochemical oxygen demand results in October and December 2004. The only value greater than the detection limit is highlighted.

Station	10/12/2004	10/13/2004	10/5/2004	12/8/2004
13-ADA-00.5	<2			<4
13-ADA-UNK	<2			<4
13-AYE-00.0		<2		<4
13-BUT-00.1			<2	<4
13-ELL-00.0	<2			<4
13-IND-00.2			<2	<4
13-MIS-00.1			<2	<4
13-MOX-00.0			<2	<4
13-PER-00.1			***3***	<4
13-SPU-00.0			<2	<4

Table 6. Discrete flow measurements (cfs) for the 2004 study period.

January through March 2004

Station	1/13/04	1/14/04	1/27/04	1/28/04	1/29/04	2/10/04	2/11/04	2/24/04	2/25/04	3/9/04	3/10/04	3/23/04	3/24/04
13-ADA-00.5	2.1		1.1			1.5		1.1		0.5		0.2	
13-ADA-UNK													
13-AYE-00.0		4.1			3.5		3.9		2.7		1.9		2.3
13-BUT-00.1	3.2		1.7			1.5		1.4		1.2		0.5	
13-CHA-00.1		6.3					6.5		7.8	7.6			6.9
13-ELL-00.0	4.0					4.8		2.9		3.5		2.7	
13-ELL-33RD													
13-IND-00.2	4.7		3.2			3.5		3.3		2.9		2.5	
13-IND-MART													
13-MIS-00.1	1.3		1.1			1.2		1.1		1.0		0.8	
13-MIS-BETH													
13-MIS-ETHR													
13-MOX-00.6	13.6					10.4		10.1		9.3		10.0	
13-REI-00.9		20.5		16.7		14.0			8.1		8.1		7.4
13-SCH-00.1	2.8		2.1			2.2		2.4		2.1		2.1	
13-SPU-00.0		27.5		23.4			26.0		18.2		12.9		15.5

April through June 2004

Station	4/20/04	4/21/04	5/5/04	5/18/04	5/19/04	6/8/04	6/22/04	6/23/04
13-ADA-00.5	0.1		0.01			0.01	0.01	
13-ADA-UNK	0.3		0.1	0.1		0.1	0.05	
13-AYE-00.0		1.8	1.5		1.1	0.9		0.7
13-BUT-00.1	0.8		0.2	0.1		0.1	0.1	
13-CHA-00.1		4.2	3.2		2.2	2.1		2.1
13-ELL-00.0	2.9		1.7	2.3		1.6	1.3	
13-ELL-33RD								
13-IND-00.2	2.2		1.5	1.5		1.3	1.2	
13-IND-MART								
13-MIS-00.1	0.8		0.7	0.5		0.5	0.4	
13-MIS-BETH								
13-MIS-ETHR								
13-MOX-00.6	9.9		8.2	8.9		8.5	7.2	
13-REI-00.9		4.0	1.7		1.2	2.8		1.4
13-SCH-00.1	2.2		2.0	1.9		2.2	1.6	
13-SPU-00.0		12.2	10.2		7.7	6.2		4.7

July through September 2004

Station	7/7/04	7/20/04	7/21/04		8/25/04	9/14/04	9/15/04	9/28/04	9/29/04
13-ADA-00.5									
13-ADA-UNK	0.03	0.01							
13-AYE-00.0	0.3		0.3		0.9		0.9		0.7
13-BUT-00.1	0.1	0.1		0.1		0.1			
13-CHA-00.1	1.8		1.4		2.0		1.4		
13-ELL-00.0	1.2	0.7		1.0		0.8		0.6	

13-ELL-33RD									
13-IND-00.2	1.0	0.8		1.4		0.9		1.0	
13-IND-MART									
13-MIS-00.1	1.0	0.2		0.3		0.3		0.3	
13-MIS-BETH									
13-MIS-ETHR									
13-MOX-00.6	7.9	7.3		8.4		8.3		8.3	
13-REI-00.9	1.2		0.4		2.3		4.5		1.4
13-SCH-00.1	1.8			1.1		1.1			
13-SPU-00.0	1.7		2.2		5.8		6.1		4.5

October through December 2004

Station	10/5/04	10/12/04	10/13/04	10/26/04	11/16/04	11/30/04	12/7/04	12/8/04	12/14/04	12/28/04
13-ADA-00.5							0.2	0.7	0.7	0.1
13-ADA-UNK		0.1		0.1	0.1	0.1	0.4	1.0	1.1	0.2
13-AYE-00.0			0.8	1.1	1.0	1.1			1.8	1.5
13-BUT-00.1	0.1	0.1		0.3	0.1	0.1		3.4	4.1	0.6
13-CHA-00.1			0.9	1.3	1.0	1.2			2.6	1.6
13-ELL-00.0		0.7						8.1	6.4	2.2
13-ELL-33RD								2.2		
13-IND-00.2	1.0	1.0		2.9	0.9	1.1			6.1	1.2
13-IND-MART							0.6	1.2		
13-MIS-00.1	0.3	0.3		1.1	0.4	0.4			2.0	0.4
13-MIS-BETH							0.8	1.2		
13-MIS-ETHR							0.8	1.1		
13-MOX-00.6	7.9	7.9		12.0	8.4	8.1	11.0	16.4	19.7	9.1
13-REI-00.9			4.3	5.1	3.5	6.1			22.0	6.0
13-SCH-00.1				1.4	0.8	1.1			4.9	0.9
13-SPU-00.0	5.1		5.1	7.1	6.4	7.3			11.8	10.3

Table 7. Fecal coliform data collected during dry weather (October) and wet weather (December) conditions. Highlighted values are >200/100 mL.

Station	10/5/2004	12/7/2004	12/8/2004
13-ADA-00.5		220	8875
13-ADA-UNK		560	420
13-AYE-00.0		2	37
13-BLA-00.0	6	33	74
13-BLA-02.3		8	9
13-BUT-00.1	2	90	145
13-BUT-NW	2	53	100
13-BUT-SE	84	40	129
13-BUT-SW	65	160	370
13-ELL-00.0		56	207
13-ELL-33RD		56	185
13-IND-00.2	92	440	620
13-IND-12TH		6	47
13-IND-BOUL	170	410	980
13-IND-FRED	100	690	550
13-IND-MART	4200	710	4485

13-IND-SBAY	1100	760	915
13-IND-WHEE	180	480	725
13-MIS-00.1	330	790	300
13-MIS-BETH	435	550	250
13-MIS-ETHR	180	705	95
13-MOX-00.0	130	860	730
13-MOX-00.6	60	120	385
13-MOX-5TH	77	1400	815
13-MOX-8TH	71	170	427
13-MOX-PARK	9	270	192
13-MOX-PLUM	20	44	203
13-PER-00.1	12	71	68
13-PER-01.0	72		59
13-PER-02.3	84		
13-PER-54TH	33	16	55
13-SPU-00.0	29	6	27
13-SPU-EQUU	33	7.5	17
13-SPU-LATI	19	10	18
13-SPU-MOOD	15	10	15

Table 8. Phytoplankton species and taxa found in Capitol Lake in summer 2004.

Achnanthes hauckiana	diatom	*Lyngbya sp.*	blue green
Achnanthes lanceolata	diatom	*Melosira ambigua*	diatom
Achnanthes linearis	diatom	*Melosira granulata angustissima*	diatom
Achnanthes minutissima	diatom	*Melosira varians*	diatom
Amphora ovalis	diatom	*Navicula capitata*	diatom
Amphora perpusilla	diatom	*Navicula contenta biceps*	diatom
Anabaena circinalis	blue green	*Navicula cryptocephala*	diatom
Anabaena flos-aquae	blue green	*Navicula cryptocephala veneta*	diatom
Anabaena planctonica	blue green	*Navicula decussis*	diatom
Ankistrodesmus falcatus	green algae	*Navicula gregaria*	diatom
Asterionella formosa	diatom	*Navicula menisculus upsaliensis*	diatom
Caloneis ventricosa minuta	diatom	*Navicula minima*	diatom
Chlamydomonas sp.	green algae	*Navicula pupula*	diatom
Chrysococcus rufescens	chrysophyte	*Navicula reinhartii*	diatom
Cocconeis placentula	diatom	*Navicula rhynchocephala*	diatom
Coelastrum microporum	green algae	*Navicula sp.*	diatom
Cryptomonas erosa	cryptomonad	*Nitzschia acicularis*	diatom
Cyclotella atomus	diatom	*Nitzschia amphibia*	diatom
Cyclotella meneghiniana	diatom	*Nitzschia communis*	diatom
Cyclotella pseudostelligera	diatom	*Nitzschia dissipata*	diatom
Cyclotella stelligera	diatom	*Nitzschia fonticola*	diatom
Cymbella minuta	diatom	*Nitzschia frustulum*	diatom
Cymbella sinuata	diatom	*Nitzschia innominata*	diatom
Cymbella sp.	diatom	*Nitzschia palea*	diatom
Diatoma hiemale mesodon	diatom	*Nitzschia paleacea*	diatom
Diatoma tenue elongatum	diatom	*Nitzschia sigmoidea*	diatom
Eunotia pectinalis	diatom	*Nitzschia sp.*	diatom
Fragilaria brevistriata	diatom	*Nitzschia volcanica*	diatom
Fragilaria capucina mesolepta	diatom	*Oocystis lacustris*	green algae
Fragilaria construens	diatom	*Oscillatoria sp.*	blue green
Fragilaria construens venter	diatom	*Rhodomonas minuta*	cryptomonad

Fragilaria crotonensis	diatom	*Rhoicosphenia curvata*	diatom
Fragilaria pinnata	diatom	*Scenedesmus abundans*	green algae
Fragilaria vaucheria	diatom	*Scenedesmus quadricauda*	green algae
Glenodinium sp.	dinoflagellate	*Selenastrum minutum*	green algae
Golenkinia paucispina	green algae	*Stephanodiscus astraea minutula*	diatom
Gomphonema acuminatum	diatom	*Stephanodiscus binderanus*	diatom
Gomphonema angustatum	diatom	*Stephanodiscus hantzschii*	diatom
Gomphonema olivaceum	diatom	*Surirella ovata*	diatom
Gomphonema sp.	diatom	*Synedra rumpens*	diatom
Gomphonema subclavatum	diatom	*Synedra ulna*	diatom
Gomphonema tenellum	diatom	*Trachelomonas crebea*	euglenoid
Hantzschia amphioxys	diatom	*Trachelomonas pulchella*	euglenoid
Kephyrion littorale	chrysophyte	*Trachelomonas volvocina*	euglenoid
Kephyrion sp.	chrysophyte	*Unidentified flagellate*	dinoflagellate
		Westella linearis	green algae

Table 9. Draft sediment oxygen demand estimates for Capitol Lake benthic flux chambers, based on estimated dimensions.

Unit	Station	Time Deployed	Light chamber SOD ($g/m^2/d$)	Dark chamber SOD ($g/m^2/d$)
1	Middle Basin, southwest corner	47	-0.9	N/A
2	Middle Basin, east side	21	-0.4	-1.8
2	North Basin	19	N/A	-1.4
3	South Basin	28	-0.8	-1.1

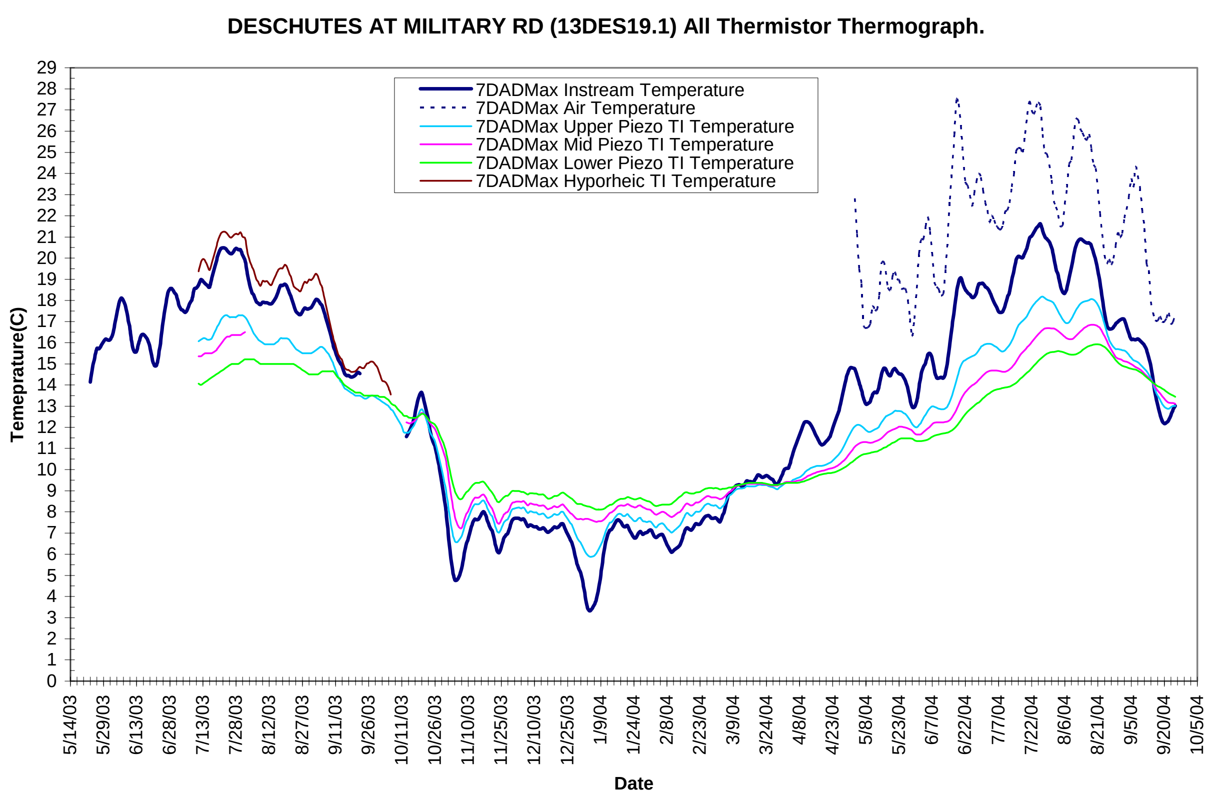

Figure 1. Example temperature monitoring results for the Military Road site on the Deschutes River.

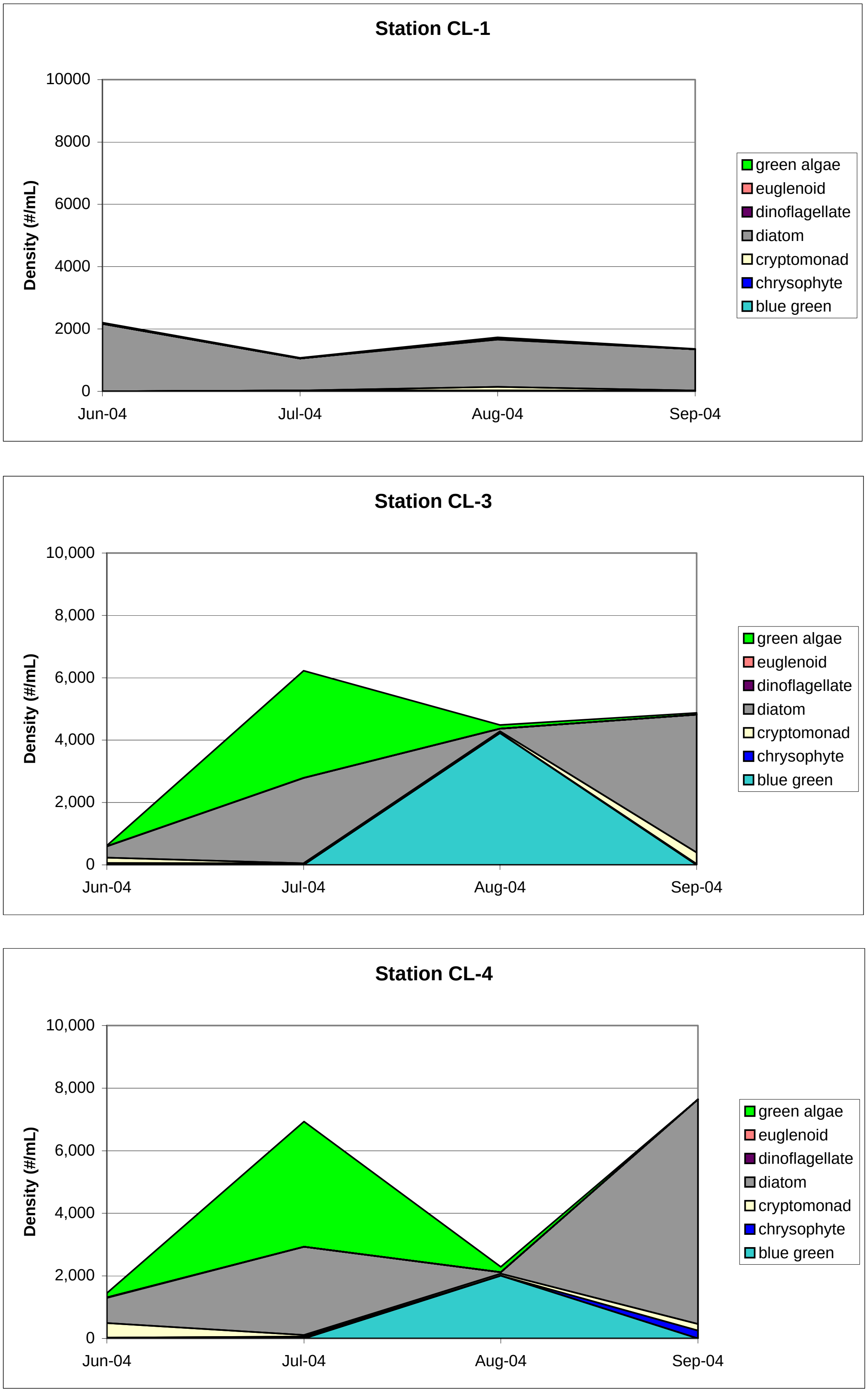

Figure 2. Phytoplankton density (#/mL) at three Capitol Lake stations.

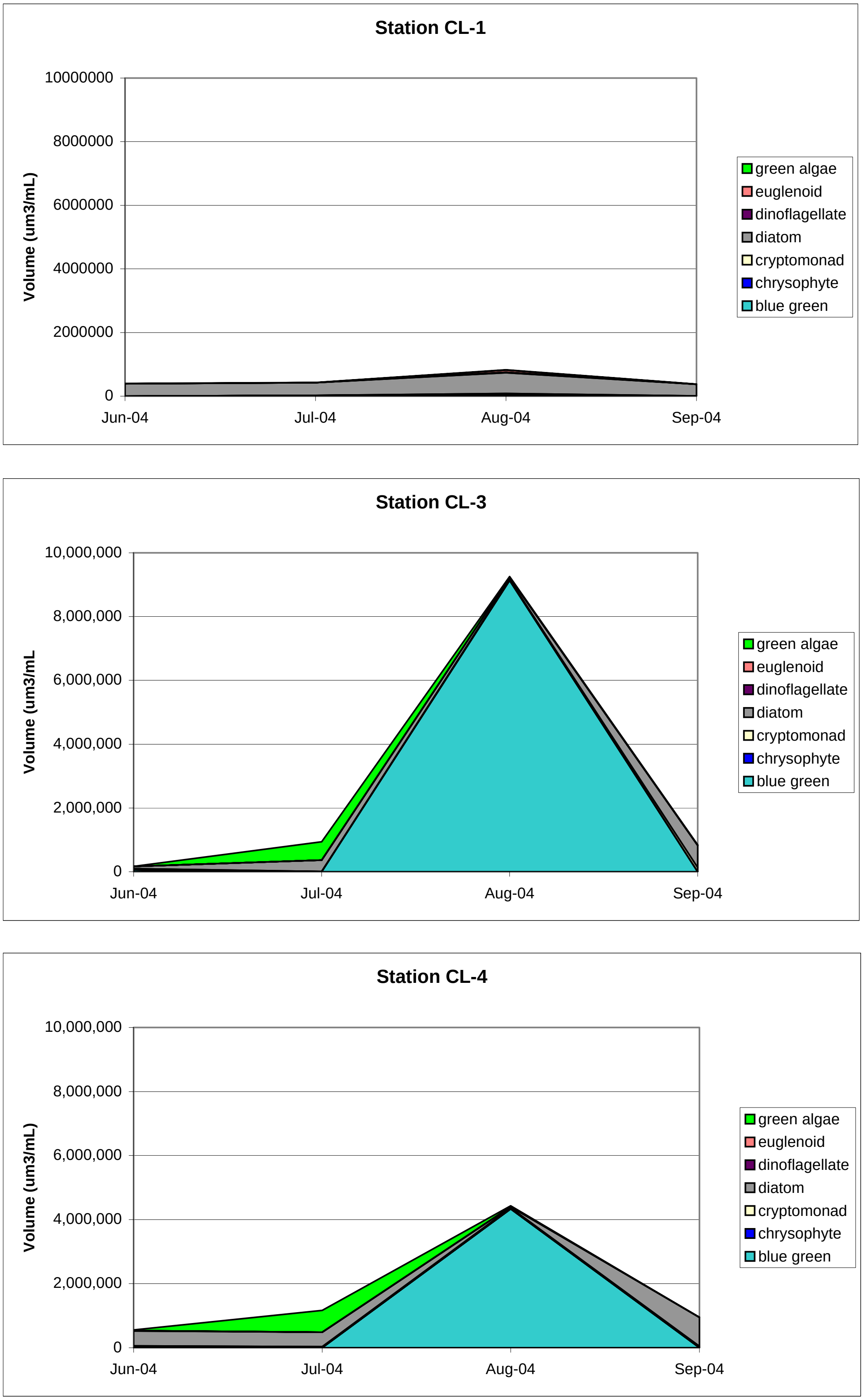

Figure 3. Phytoplankton volume (um3/mL) at three Capitol Lake stations.

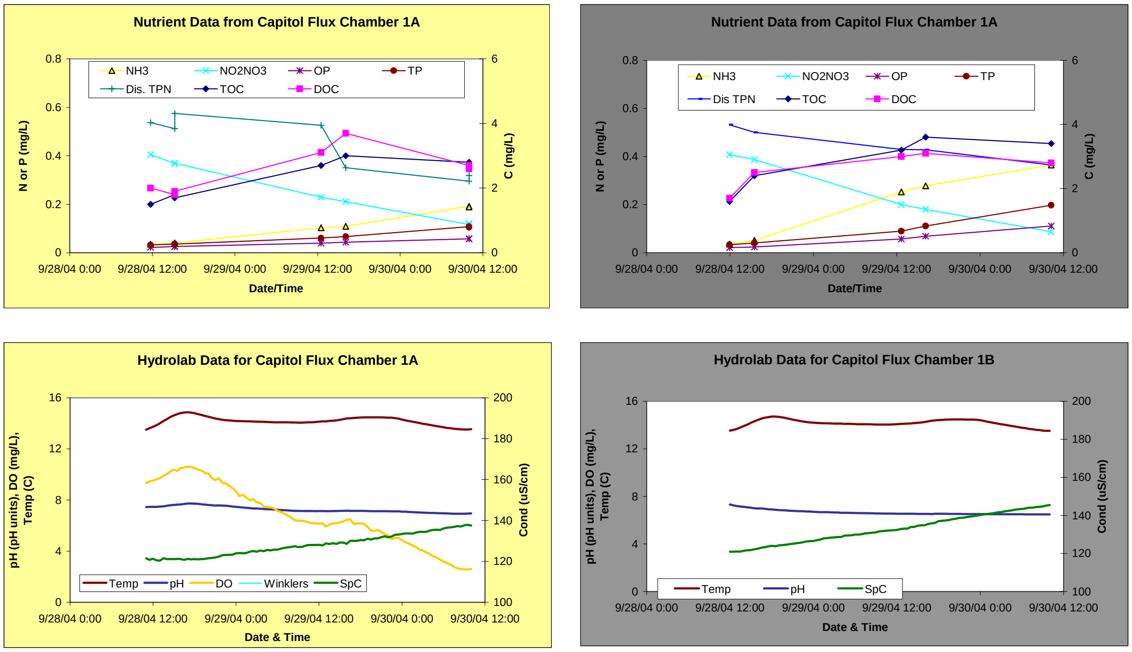

Figure 4. Discrete nutrient sample results and continuous DO, temperature, conductivity, and pH data from benthic flux chamber #1 deployed in the southwest corner of the middle basin of Capitol Lake. Yellow indicates light chamber and gray indicates dark chamber results.

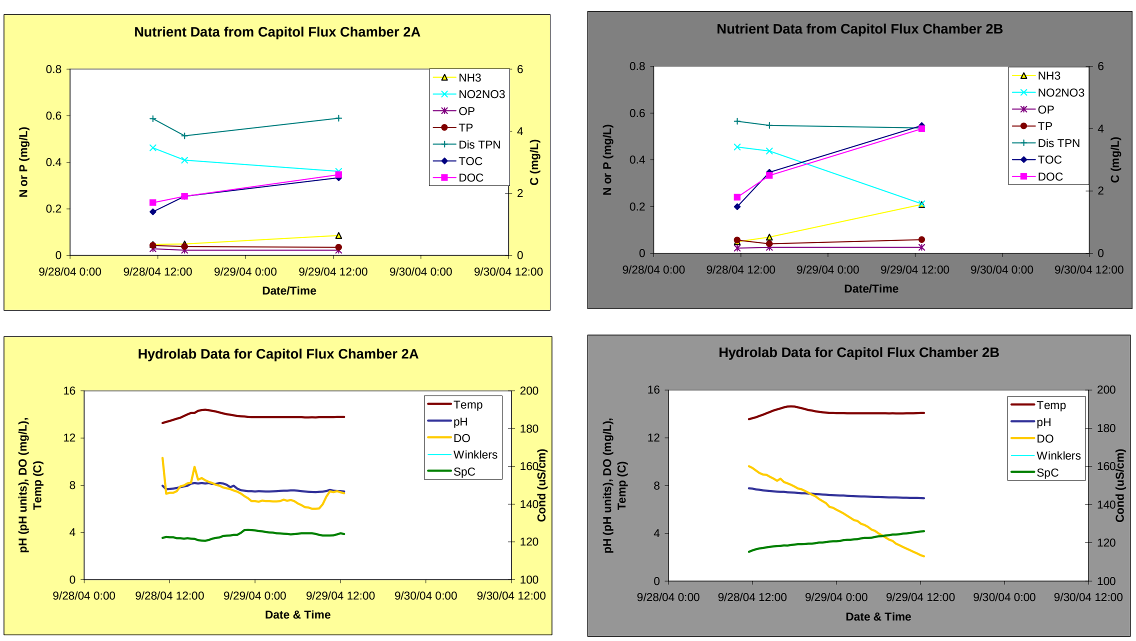

Figure 5. Discrete nutrient sample results and continuous DO, temperature, conductivity, and pH data from benthic flux chamber #2 deployed on the east side of the middle basin of Capitol Lake. Yellow indicates light chamber and gray indicates dark chamber results.

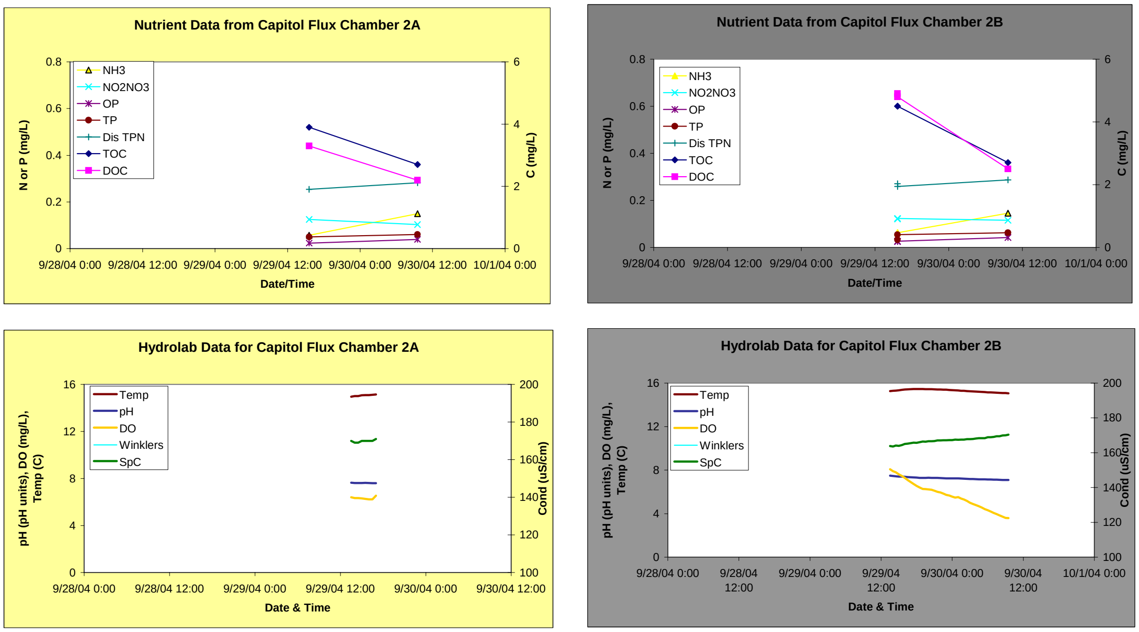

Figure 6. Discrete nutrient sample results and continuous DO, temperature, conductivity, and pH data from benthic flux chamber #2 deployed in the north basin of Capitol Lake. Yellow indicates light chamber and gray indicates dark chamber results.

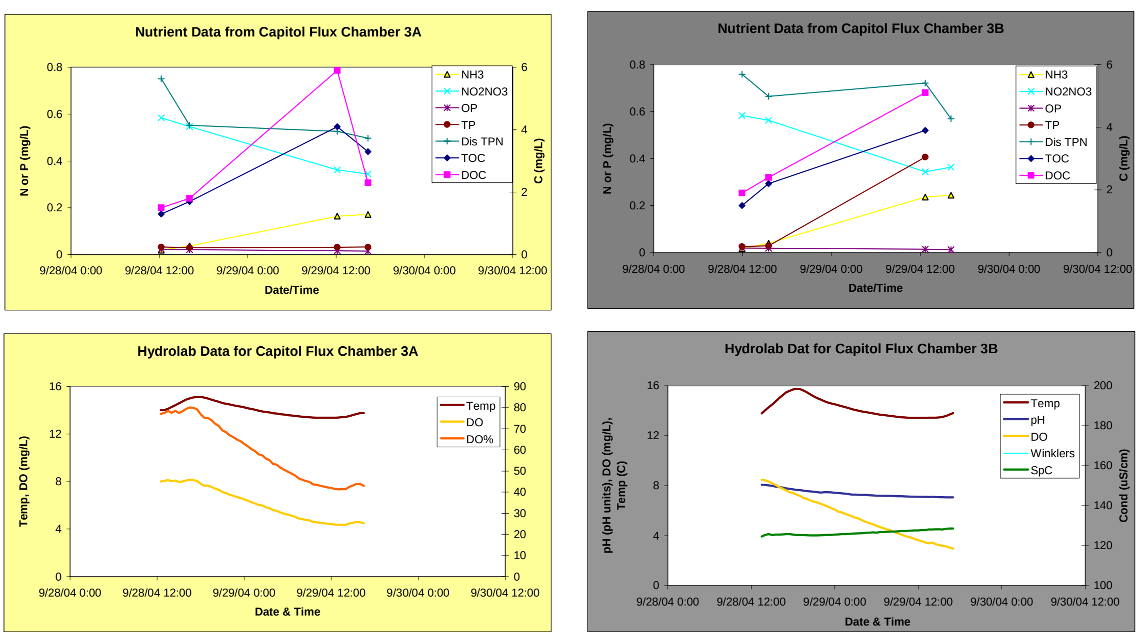

Figure 7. Discrete nutrient sample results and continuous DO, temperature, conductivity, and pH data from benthic flux chamber #3 deployed in the south basin of Capitol Lake. Yellow indicates light chamber and gray indicates dark chamber results.